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Proceedings of the Pacific regional advisory meeting on the Recovery Potential Assessment of Pacific Eulachon (*Thaleichthys pacificus*)

March 23-24, 2011
Nanaimo, B.C.

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Editor: Sean MacConnachie

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Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

These Proceedings summarize the relevant discussions and key conclusions that resulted from a Fisheries and Oceans Canada (DFO), Canadian Science Advisory Secretariat (CSAS) Regional Advisory meeting of March 23-24, 2011 at the Pacific Biological Station in Nanaimo, B.C. One working paper focusing on the information required in support of a recovery potential assessment for Eulachon was presented for peer review.

In-person and web-based participation included Fisheries and Oceans Canada (DFO) Science branch, Ecosystems Management branch and Fisheries and Aquaculture Management branch staff; and external participants from First Nations organizations, the commercial, environmental non-governmental organizations and American federal government.

The supporting Research Document will be made publicly available on the Canadian Science Advisory Secretariat (CSAS) website.

Compte rendu de l'examen par les pairs de la région du Pacifique sur l'Évaluation du potentiel de rétablissement (EPR) de l'eulakan (*Thaleichthys pacificus*)

SOMMAIRE

Le présent compte rendu résume l'essentiel des discussions et conclusions de la réunion du processus consultatif régional du Secrétariat canadien de consultation scientifique (SCCS) de Pêches et Océans Canada (MPO), qui s'est tenue les 23 et 24 mars 2011 à la station biologique du Pacifique de Nanaimo, en Colombie-Britannique. Un document de travail portant sur les renseignements requis à l'appui d'une évaluation du potentiel de rétablissement de l'eulakane a été présenté aux fins d'examen par les pairs.

Étaient présents, en personne ou en ligne, des représentants de la Direction des sciences, de la Direction de la gestion des écosystèmes et de la Direction de la gestion des pêches et de l'aquaculture de Pêches et Océans Canada (MPO), ainsi que des participants externes provenant des organisations des Premières Nations, d'organisations non gouvernementales commerciales et de l'environnement et du gouvernement fédéral américain.

Le document de recherche à l'appui sera rendu public sur le site Web du Secrétariat canadien de consultation scientifique (SCCS).

INTRODUCTION

A Fisheries and Oceans Canada (DFO) Canadian Science Advisory Secretariat (CSAS), meeting was held on March 23-24, 2011 at the Pacific Biological Station in Nanaimo to review information in support of the development of a recovery potential assessment for Eulachon.

The Terms of Reference (TOR) for the science review (Appendix A) were developed in response to a request for advice from the DFO Species at Risk program. Notifications of the science review and conditions for participation were sent to representatives with relevant expertise from First Nations, commercial and recreational fishing sectors, environmental non-governmental organizations and academia.

The following working paper was prepared and made available to meeting participants prior to the meeting

Information in Support of a Recovery Potential Assessment of Eulachon (*Thaleichthys pacificus*) in Canada by Chantal Levesque and Thomas Therriault.

The meeting Chair, Sean MacConnachie, welcomed participants, reviewed the role of CSAS in the provision of peer-reviewed advice, and gave a general overview of the CSAS process. The Chair discussed the role of participants, the purpose of the various publications (Science Advisory Report, Proceedings and Research Document), and the definition and process around achieving consensus decisions and advice. Everyone was invited to participate fully in the discussion and to contribute knowledge to the process, with the goal of delivering scientifically defensible conclusions and advice. It was confirmed with participants that all had received copies of the Terms of Reference and working papers

The Chair reviewed the Agenda (Appendix C) and the Terms of Reference for the meeting, highlighting the objectives and identifying the Rapporteur for the review. The Chair then reviewed the ground rules and process for exchange, reminding participants that the meeting was a science review and not a consultation. The room was equipped with microphones to allow remote participation by web-based attendees, and in-person attendees were reminded to address comments and questions so they could be heard by those online.

Members were reminded that everyone at the meeting had equal standing as participants and that they were expected to contribute to the review process if they had information or questions relevant to the paper being discussed. In total, 46 people participated in the RAP (Appendix B).

Caroline Wells was identified as the Rapporteur for the meeting.

Participants were informed that Megan Moody and Doug Hay had been asked before the meeting to provide detailed written reviews for the working paper to assist everyone attending the peer-review meeting (Appendix D). Participants were provided with copies of the written reviews.

The conclusions and advice resulting from this review will be provided in the form of a Research Document and will be made publicly available on the Canadian Science Advisory Secretariat (CSAS) website.

REVIEW

Working Paper:	Information in Support of a Recovery Potential Assessment for Eulachon (*Thaleichthys pacificus*) in Canada
Rapporteur:	Caroline Wells
Presenter(s):	Chantal Levesque

PRESENTATION OF WORKING PAPER

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) is tasked in with determining the level of risk of extinction a species in facing. When a species is found to be Threatened or Endangered, DFO standard practice is to undertake a recovery potential assessment (RPA) to inform listing decisions and subsequent recovery planning. COSEWIC had not yet assessed Eulachon at the time of the meeting with expectation that the assessment would be in April 2011. Eulachon have experienced declines in recent decade throughout most of their range. It was fully expected at the species level, or portions of the population, would be found at risk. The working paper was initiated in anticipation of COSEWIC findings and to align with available resources.

A First Nations participant expressed appreciation of the workshop being held today. The historic background for the Eulachon fishery is that the powers that be, have up until now, overlooked the fishery. The point is that this is being looked at after the fact of development of the rivers. We need to question the actions and policies of the economic stability of what we are doing. I'm hoping to see that there are some resources that come along with that recovery; tangible stuff. I'm hoping that the recovery effort that is happening right now on the species stays as is. You have to understand for First Nation there is a process for respect for the species. We are facing a lot of resource development right now on our territory. Look at the communities where we come from and you can see the tragic situations, planning for a fishery like Eulachon is year round. It is important for us to frame this to let you know that we see constant pressure on our rivers and our mountains. We are grateful for the bounty we have and we would like to share it but there has to be a careful balance. This will have an incredible impact for our people.

Chantal Levesque presented the Working Paper

Questions of Clarification

- Questions arose around how marine habitat was not limiting based on recent surveys in the habitat modeling exercise. Have suitable habitat been found where Eulachon is not present. Further research is recommended to confirm linkage between marine habitat and eulachon abundance. The environmental variables that the model is built on are specific to a certain time period, to answer this questions we would need the environmental data from the past.
    - **Recommendation:** Tone down the language around habitat suitability and limitations.
- Do we have a good sense of the genetic composition offshore?
    - Some of the baselines right now have a small sample size, if those could be increased we could get better estimates and recommendations to get more inter-annual samples within rivers, to increase the measures between inter-annual variations than between river systems
    - There is quite a bit of uncertainty because our baselines are incomplete
- The research only looks at one study area, the Fraser River, but what about the rest of BC? I see the impacts to First Nations on resource availability. From the First Nations perspective

we need to be more heard. There should have been an agenda where First Nation could speak, in showing site specific areas and First Nations experiences. When you look up the demise of the industry, you can see the change in species composition; does this have a bearing on what is transpiring? Our communities are concerned about this. I compare this to health issues; we don't need anymore damage done to our resources. There is a lot of reference made to our local villages, Eulachon used to be present in a lot of the rivers. The impacts of this are far-reaching. Cutting off access will limit us from feeding future generations. The existence of First Nations people need to be protected as well. We need to share our knowledge of the Eulachon and the impacts with this table.

  - We all recognize that each stream is different. Part of DFO's process is using TEK and looking at the SARA process and what impacts that will have on communities.

- We cannot recommend to our community that the Nass River be considered under listing for this process. When I look at a lot of the data, there is reference to Fraser River; there is no research on parasites. We take size and egg weight and discovered this year there is a parasite on the Eulachon, we identified it present in 2 or 3 samples. When you look at habitat limitations, how is it when different systems go through an area, how does one system do better than another?
  - That is a good question; this may be an answer that we find today. The Minister will know that there are differences in these populations.
- Eulachon decline is not synchronous. There are different factors that affect different populations. Things causing decline may not be marine, there are a lot of things going on in freshwater environment. Changes in flow, changes in sediment contribution that affect the habitat for laying eggs. I would like to suggest that the decline in Eulachon in the Kitimat River is due to a change in the sediment contribution, the eggs cannot attach to the sediment. The presence of Alcan is attracting Eulachon in and have not had suitable habitat. There has been no degradation to habitat around those areas. We need to focus changes in hydrology, changes in sediment contribution (dikes).
- In the presentation, discussed threats – is there a 1 tonne threshold that is missing from the paper that puts some out in section 5 and 6? It appeared that there was a threshold on what's included in or out.
  - We are missing some mitigation scenarios, we don't know what an acceptable amount of removal would be.
- The Skeena is having another good year, we have concerns about the types of harvesting that is going on. It is really hard to say where marine mortality is coming from, there is basically 3 distinct life cycles here. The early marine life history is where they get knocked off; this is not captured in the modelling. The marine habitat is not static. Wondering if we could have a little more tie in the marine component and the estuary component, I didn't see the level of specificity on the trawl data and the ocean habitat suitability model.
- There has been a trend in decreased oxygen levels in the ocean, this might be a factor in contributing to limiting habitat
  - Trawl data is lacking a historical reference point, have been tracking oxygen levels for 5 years now. We could potentially track this
- Climate change has not been specifically mentioned, the paper doesn't mention this. Hatching times and larval feeding in the estuary, productivity in the estuary may be a contributing factor. It is important when hatch at a certain time and there is no food in the

estuary, will be impactful. Would like to suggest that this be an area added into the area and looked at in the future.

  - I haven't read any studies that have looked at that or analyzed that. Can comment generally, this would be subsequent research. Can include this element in the paper and the in depth research would be another paper

- Caught Eulachon from 30 -40 mm in estuary –a significant size. The health of the estuary has to have significant impact on Eulachon survival. The ecosystem function in the estuary may affect prey availability, found the Eulachon from April-August, this matches the salmon run through the estuary. Species identification Eulachon from Long-fin smelt can be difficult and may contribute to the disparity in the offshore biomass indices.
- How confident are those that are sampling in identification? We are very confident identification in offshore. It is hard to identify larval Eulachon, we are running into different marine species such as Herring, etc. We are clear on what Eulachon look like but if they are damaged it may cause more difficulty.
  - The biomass indices don't get hung up on the magnitude, they are relative indices. Magnitude isn't an issue here, just the trends over time.
- Under the section on fisheries impact by-catch on Eulachon – a more equitable treatment of mitigation seems one-sided and would like to suggest the wording be changed to reflect that.
- When a sensitive species like Eulachon impacted by agriculture, industry, run-off, etc. in the Fraser river – this is a flag for caution
- Some of the graphs may not be labelled correctly, please look at the labelling
- Salmon farms have not been mentioned in this paper
- Might be worthwhile to expand regime shift to include the work that has been done by NOAA looking at biomass regime shifts in Alaska

WRITTEN REVIEWS

Doug Hay

Review presented by Jake Schweigert:

- I think we have heard conflicting views on the work done on the freshwater environment. I would throw this to the group, have we captured the freshwater and marine environment enough.
- The template is complex, and has redundancy checks. A clear delineation in reference to specific elements that are not provided in this document. The template is a guidance document and you can change it to tell the story. We will try to clarify the confusion within the template.
- Doug does hit on the fact that DFO is not spending enough on Eulachon. One thing we can do is try to consolidate the research recommendations that would fill the most gaps. This feeds into future research needs, something we could work on. This document isn't like typically advisory documents that focus on research; we can come up with an informed list of research needs.

- We need to be a little bit careful on what this document in for, it is to inform a listing decision so it is important to flag the gaps that inhibit our ability to provide the advice to make the listing and develop the recovery strategy.
- Figure 4.C. requires clarification and explanation – concern over CPUE estimates and suggest that these don't seem to be doing on what they are explained as doing in the paper
- This survey ended in 2003 – surveys with a different net and gear design was used in 2005 – can't be entirely comparable.
- The only way you can start to compare indices between offshore and a river is between years not between indices due to the methodology (minimum estimate). Should have a different algorithm involved in the extrapolation process. Can't start comparing them with other index's. This is the base of the problem of the disparity between the offshore and inshore.
- In the paper, the numbers are explained as absolute numbers and they are used to compare in the paper.
- I see huge disparities in the trends, may see an increase in the marine index and not see one in the freshwater index – where did they go? Need to learn more on what indices do we trust and use?
- Question of semelparity and iteroparity, Doug's suggestion that Eulachon may not die after they spawn.
    - Have found no evidence that they are iteroparous
    - Agree that they are semelparous.
    - There are more details in the COSEWIC document
    - After the COSEWIC meeting, we will have confirmation on designatable unit structures and population structure.
- I think what he is suggesting that the Shrimp fishery took off from the regime shift. The biomass index from the survey would be more relevant.
- Recommend a more in-depth analysis of the regime effects on Eulachon. Main concern is that is much effort looking at regime shifts over climate change
    - We can comment on this, but analysis of this is beyond the scope of this paper.
- There is a need for more of a balance in the paper. There is more information on marine than there is for FW that's why the paper seems unbalanced
- Two distinct scenarios, fishing for shrimp affects Eulachon and when conditions are good for shrimp, Eulachon increases – this fact is worth articulating in the paper
- Needs to be more information on the background on the history of the shrimp fleet, prices, by-catch and why there has been closures in some areas to fully explain why the shrimp fishery affects by-catch of Eulachon
- Another scenario to fit the model is the when shrimp population are high, eulachon populations are high – you get a cleaner catch of shrimp and a decrease in by-catch because it is cleaner catch – also need to look at political vs. scientific by-catch policy (?)
    - The future work suggested by Doug is all possible, and is helpful for future recovery work but the scope of this paper is for a listing decision

- One question, global warming is causing glaciers to melt and the mosses are becoming thicker and growing where the spawning beds used to be. Is there work going to be done to investigate this? We were wondering if when they hatch they are getting tangled in the moss and not making it all the way down the river
    - No work has been done to look at changes in the flora and fauna in the river and changes in hydrology
- Have you looked at size differentiation across populations?
    - No work has been done to investigate this
- Need to look at shrimp trawl data, beam trawl boats move slower and have differences in gear types and I don't think we are capturing the actual spatial usage of marine habitat by eulachon.
- The estuary itself is unique and we have only just found that Eulachon is in the estuary for a longer period of time. Study done in San Francisco found that Long Fin Smelt (relative of Eulachon) is displaced by agricultural water withdrawal which decreases salinity in estuaries and thus the productivity. This may or may not have an affect of eulachon larvae mortality.

Megan Moody

Presentation on Eulachon and the First Nations

- 5 – 6,000 people would come in the spring to prepare for Eulachon arrival, communities were built around the run. 700 – 1000 tonnes used in the spring time
- What is happening now with the runs in unusual, the runs back then would have had to sustain growing communities
- What happens to all of the fish bodies when the grease has been obtained?
    - There is a whole in the container and the bodies go back into the river, people also use it for fertilizer.
    - Several families usually worked together on harvesting and processing and they would get there share of the grease
- The RPA process seemed rushed, because the COSEWIC process has been lagging for so long but it is due to funding
- The timing of the meeting needs to be looked at, Eulachon meetings all seem to be popped up in March – we need to rule out March and April because this is Eulachon season.
- Would like to know where the 3 DU's comes from?
    - Originally the DU structure that was proposed was 8 or 9. The Marine Fish sub-committee reduced it to 3 DU's. They do follow a template, in terms of coming up with DU's. The reasoning was genetics alone was not enough to delineate DU's.
- Would like to caution that the Eulachon in Knight's inlet is not as depleted as central coast populations, shouldn't be clumped in with those populations.
    - This would fit in more with the socio-economics of the listing
- Would like to see the unpublished reports if they are available?
- Abundance: Overall this was good, but it was a summary of COSEWIC report. It would be good to have an update of the status of the 9 rivers. Skeena has been good and is having a

good run this year, this should be noted. Updates could be done to this system involving FN. It might be a good idea to develop a standard form, a qualitative survey, for FN to update the system each year. Guardian Watch Network – develop a report for FN data on stock status

- Recent scientific research by FN should be included in the RPA
- **FW Habitat Extent:** Found this confusing, it's not supposed to be an exhaustive list of areas by river rather a summary of known areas of habitat. Might be better to say "this is a large system – here is where they spawn and compare to a smaller system – and look at where they spawn" More information could be given
    - Good Suggestion – may cover some of the data between the rivers.
- **Marine Part**: Have a statement at the beginning about how the biomass indices are to be used – explain why or why not these indices are or aren't used
- The habitat suitability model will be useful – interesting to see it run with broader biological data
    - **Suggestion:** There in no changes in habitat quality since the decline – some water quality has improved since the decline – need examples to back up statement
- Under SARA that is listed as EN we have to identify CH – to understand the CH for a fish the spend the life in different habitats, it's hard to identify what part of their habitat is more important than the other
    - Way too look at it, is if this habitat changes in its quality or quantity will it impact the Eulachon life cycle. There is a spatial component but there is also a quality component as well (temp of water, amount of gravel)
- Offshore indices are not correlated with river indices.
    - We weren't comparing the individual indices (values in the index) we were looking at the differences (trends) between the indices
- Distribution targets: Recommend to have approx. 7 rivers along the BC coast monitored annually or catch monitoring. These should be conducted by FN as they are being fished by FN. This would give us a better idea of what is happening coastwide.
- To comment on the example of the precautionary reference points: comparing it to MSY – need to re-word to say systems aren't commercially fished, maximum sustainable yield signifies a commercial fishery.
    - Using the MSY are not entirely appropriate to have these reference points included in these documents
- Detailed text for the shrimp trawl fishery - no mention of the by-catch estimates, during the mid 90's a history of the shrimp fleet has an increase in effort. Also doesn't discuss the threat of by-catch on the smaller Eulachon populations. These populations are at such a low level they are decreasing.
- Groundfish Trawl Surveys – not a large source of mortality, these are being compared to the offshore SSB – may want to remove that there
    - When we were looking at this, may have been looking at this in terms of the index or the amount of kg caught in the survey.
    - SSB should be total biomass

- Thought the paper would have more management recommendations and strategy
- Comment of FN fisheries section – offence to FN fisher "further restriction on FN Fishing projects are occurring currently or future projects maybe considered" – this should be said to all other fisheries as well (commercial & recreational)
- Suggest to also include all FN catch is caught after Eulachon has spawned – FN also take conservation measures into fishing methods
- "both FN and recreational fisheries could be reconsidered for re-openings" sounds like your putting Sport fishing on the same level as First Nations – the constitution protects the FNs fishery – need to change this wording
- Eulachon action level: Based on 1% of biomass index – is this set correctly?
    - Starts with the last info available, uses the previous years biomass
- Are we using that as an absolute number again?
    - We treat the index as the absolute estimate for managing the catch. Use it for the Eulachon Action Level.
- Could this be over-catching?
    - There is confidence intervals between the shrimp indices
    - There is uncertainty, but this is the only number we can generate that forms the basis on recommendation
- I would suggest looking into the offshore indices to use for management purposes.
    - The offshore index is going to have to be a sub-committee discussion
- The offshore index seem arbitrary – what is the 1% intended to do?
    - Not really any recommendations for the management actions, need to list off recommendations
- Why were larval survey data not included on all rivers (this is in Megan's review in email)
    - Didn't have enough time to go out and do studies on all rivers and wouldn't have time to validate the data
    - Larval studies: Why would there be a question of using this methodology elsewhere?
    - Comment on where you put the gear on steep rivers and the get estimates that are not always consistent – either impacted by topography of river or flow of river – it was just a caution to flag the differences amongst the Eulachon rivers
- DFO's methodology works and I can see no substantive reason not to apply it coast wide
- Assessment of Recovery Potential: use of "most" can be re-phased, keep in mind the Nass and Skeena are experiencing higher levels
- Do you have a size/length chart for QC Sound offshore Eulachon?
    - Yes, we have data. It is similar, the point of the figure is to illustrate the bi-modal 2 offshore H classes
    - Would be interesting to see going back to the habitat requirement to see if size plays a role -
- QC Sound survey data there was a couple of points in the data prior to 1998, wondering if there was different methodology used for these points – This is an error in Figure 5A – this

may be the two westcoast Vancouver Island areas (124 & 125) – take "in excluder" out of the title and put in legend so people don't compare them

- **Habitat Suitability model** – did Jessica experiment with putting any other layers over top of it? No she did not.
- **Table 6** : "Potential Mitigation or alternative activity column" – take the Nass out of the FN fishery
    - One of the potential mitigation measures is to reduce any directed catch
    - Issue here maybe in a way is column 2 vs. column at the end of the table– confusion is there is probably more than two rivers and the follow through at the end of the table applies to the Fraser – table can be cleaned up, we don't need to specify the river
    - For commercial fishery by-catch – put almost 0 as well
    - The table is outlining all possible options based on science – this needs to go in the second to last column, its not a current mitigation but it's a potential mitigation
    - Some of this will come up in the detailed discussion on mitigation
    - What gets put on this list and how it is decided – needs to be consistent listing

Discussion and Building Agreement on Conclusions, Recommendations, Advice and Future Work

- **Recommendation:** Take out point 4 and point 8 MSY thresholds
    - To apply MSY reference points you need close modelling of stock abundance, seems like you are not going to do that for every river systems, close monitoring of population adjustments – don't think some of annual variability of this fish that this would be a stable population to use a reference points
- Only used for Fraser River, egg and larval SSB estimates, there is recognition on our part that maybe there are other ways to go but this does provide that on scientific basis for action levels – there is a stop light approach for all harvesting on the Fraser River. We took what we knew the abundance of Eulachon was and provided guidance on harvesting for the next year. If the SSB was below 150 tonnes after one year – it was a reason to raise a flag if it was below after two years- it is more of a conservation concern. One of guidance documents suggested on how to link the COSEWIC targets to the precautionary approach.
- This is a laudable effort, need to see some confidence boundaries around this index. Have other reference points been thought about? Recovery levels could be used, current stock now has not reached recovery level so may not be useful
- There are a number of assumptions based on applying the rationale for determining these reference points in Figure 10.
    - We can't even age the Eulachon, we have no idea what the mortality rates are – makes it hard to model reference points
- What needs to be done to explore scenarios that looks at targets – decision can be made what target should be used looking at the range of scenarios for recovery
- Less lofty goal for recovery is to get it list as SC – the minimum goal for recovery is to change the trajectory and get the population to move up – these benchmarks are fine, need to look at what it would take to move above these thresholds and how do we do that?
- What are the range of alternative approaches for setting recovery targets for this committee to review and which ones have the science behind them?

- Might it be applicable to study the old approaches of studying benchmarks? This requires more data and the document should discuss them.
    - We will go away and look to see if there is something else we can use
    - In terms of confidence intervals in terms of the SSB estimate – the methodology hasn't changed, use a bootstrapping technique, for the size of the thing its overkill, the limiting factor is whether you are getting representative samples and that comes down to money/funding.
- Algorithm used to assess the offshore survey methodology. Does the committee want to discuss this?
    - The method is used to calculate an index, it's used year after year.
    - The other component is the using the index as an absolute estimate.
- The proof of the method would be is it working? Has to be some kind of adaptive management to the index. Next steps would be to get scenarios involved recommending different cut-offs. Can we offer science advice on what would be recommended for each scenario?
- In developing the eulachon action level as 1% of offshore index, would be curious to see if analysis of eulachon distribution offshore is similar in scale, patchiness and density to shrimp distribution?
    - No, it was a management set point
- What proportion of Eulachon does the offshore index (1%) represent from year to year?
    - The distribution barriers throughout each year, tough to go by that
    - It has to do with the amount of water is sieved with nets – if that was the case, it would explain a lot of these patterns – did you look at the trawl effort and compare to collapses and synchronicity of the population decline? There is a latitudinal trend related to decline. Seems to be a very plausible that fishing be looked at.
    - Look into spatial trawl effort and see if there is differences in decline – could be a total DU for trawl effort
    - The question is by-catch and we don't know – it's a data gap
- What's more important marine habitat or FW Habitat?
    - These are not mutually exclusive things, we can't dismiss the FW things, let's keep track of FW issues in terms of decline or recovery
    - It may be that we can't do anything about recovery in BC – policy is
    - Synchronicity is always related to marine effect, synchronicity in FW can happen too. Shouldn't dismiss FW.

RECOMMENDATIONS

Paper accepted with major modifications.

- This paper will be a first step to the process – we will need to go back and look at DU's specifically
- We need to have a DU specific approach – the table supports this strategy/concept
- Nisga'a representative, Blair Stewart supports this process

- Through the discussion yesterday, there was mention of surveys that have been used in this paper but haven't been published – need to identify any ideas or sources of information today so that we capture that information and include it in this paper.
- There are pieces of the paper that not everyone agreed with, so we need to either pull that information out or clarify those pieces
- **Proposed Process:** We clarify the issues in the paper today, come to consensus to accept or not, authors make edits and move the paper forward, COSEWIC meets and decides on DU structure and level of risk, then we write 2 or 3 RPA working papers for each DU
- The information in the informational in support of an RPA doc will not be reiterated in future RPA documents
- **Recommendation for action item:** Need to have dialogue around whether DFO is asking the right questions, whether the scope of the document in complete, etc.
- **Recommendation**: Shrimp trawl fishery –need to use the data record and need to have data by-catch listed in this report and have it accessible to those who work with Eulachon
- **Issues flagged:** Current status of the Skeena-Nass is not incorporated, monitoring data records from the FN have not been included in this document
- No Pre-COSEWIC review was preformed, this document was done before the COSEWIC assessment
- We will include wording right before the "Species Information" section to explain where this document fits into the process

Page 1:

- Eulachon are substrate spawners not broadcast spawners
- Is this information published? No its not published
- **Recommendations**: Make a statement, purse-coming Adam Lewis and his findings on substrate spawning – Chantal L. to follow up with Adam Lewis
- **Recommendation**: Background: Completion of an RPA is a policy decision not mandated under SARA

Page 2: Status and Trends: Range:

- Larval stage in the Marine environment – Work done by Metlakatla on larval surveys in the estuary – maybe unpublished or grey literature but could be helpful to include.
    - Last sentence in this section: If they were captured in 2010, this information would useful. Metlakatla continued to catch Eulachon in 2010 in the brackish estuary waters up to 40 cm in size

Page 3: 2nd to last paragraph

- Recommendation: 3 types of offshore surveys, groundfish, herring and shrimp and start dates to end dates, "multi-species survey" will confuse a lot of people. Need to clarify that.

Page 4: Population structure:

- Need more emphasis on the genetics and the lack of comprehensive information – be more explicit on the uncertainty around this

- There is a breakdown of stocks in regional areas that was published – if this baseline in going to be used in future papers, need to highlight the fact that 58% was Columbia and 37% Fraser River.
- Recommendation for Table 1: Need to have all information – catch records, fecundity, etc. specific to each river – add a couple of columns to table 1

Page 6:

- Nisga'a has reports to forward on to the authors that Eulachon are present in that system
- This section outlines a lot of information on each river – suggest to focus more on this information in the DU papers
- There have been other studies done and an attempt to compile that information into a more comprehensive documents and forward it on to the authors to include in this document and/or future documents
- Will get a personal communication quote from the 2010 Skeena around the Skeena run abundance – was observed to be abundant
    - Also newspaper articles around the Skeena run abundance to look at for review

Page 11:

- Confusion in this section because all data in the index is dismissed because the HS cannot be validated, this is not an excuse to dismiss the analysis and index – the offshore index has not been utilized for linkages
    - **Suggestion:** strike the comments section 1.3.2 that note comparison and note that this is in an area that needs further work but we have a index – note that this data can be found in specific papers
- It is appropriate in this document to show where areas where we are data deficient so we cannot assess recovery potential
- In each section we need to be really clear what those uncertainties are and identify them as gaps
- **ACTION ITEM:** There is a paper published – Clark, Lewis, Elmer and Shrimp – Paper published on Eulachon – if you send out a list of attendees and highlight who the papers should be sent to
- **Recommendation:** Use of the words "could be" – don't use this, can't mix speculation and information – suggestion: anywhere where there appears to be that wording, segregate it out and put it in a separate section about uncertainties. Highlight the uncertainties in a much more emphatic way.
- Language in the third paragraph has been removed from this section

Section 2:

- **Suggestion**: shorten this down to "we don't know"
- **Suggestion**: This is the document is where you provide information, taking out information is not helpful to this process, this section has a lot of information
- Nisga'a will try to provide data on this section

- **Recommendation**: Doug and Megan's review and comments will also be incorporated into this revision of the document
- **Suggestion:** Take information on stock reduction analysis out of this section – too much uncertainty
    - The issue is that this information in inconclusive, not reviewed and un-published, can be identified as a gap that needs to be filled
    - If you do keep it in state "this was an attempt to include this parameter, but there was nothing published"
- Last paragraph there is no age validation
- Huge data gap in Life History Parameter, that we cannot estimate the population – we will clarify that this has not been done and will remove speculation – third paragraph in section 2
    - **Suggestion:** Include an over-arching paragraph explaining the data gap

Section 1 & 2: More information is accessible and needs to be sent to the authors to review and include in this document or flag for future documents. These sections also need to be tightened up.

Section 3: Page 13:

- 3.1 - **Suggestion:** There is very limited habitat requirement for successful reproduction – it would be good to capture this in this section
- Include a paragraph on traditional knowledge outlining their understanding/experience of Eulachon reproduction habitat
- Recommendation: We can clarify the small fraction of river length where spawning takes place
- The Eulachon are estuary spawners, the eggs do not remain attached, it's the substrate that's key – those places are created and maintained by the composition of sediment and flow of the river. In high gradient rivers – there are small reproduction areas – in a lower gradient river – the reproduction are the eggs are much more dispersed with wider reproduction range
    - We will try to capture this variance
    - Review the Paper: Endangered and threatened designation for southern distinct populations - Federal Register of January 5th.
    - Nisga'a believe their spawning grounds are up higher than is stated here
        - Is there a salinity requirement for eggs?
            - Paper done in the US states the lethal requirements for salinity
            - John Kelso will forward reference paper to authors
            - Spike and peek flow – cobble is a sad substrate for eggs, we need to keep a picture in mind of year round flows affecting habitat
                - Paper in Washington (Anne Shaffer, Allouet River) found that removal of Dam and sediment contribution allowed for Eulachon to come back to river to spawn. This is important for future Hydroelectric Dam projects
                - **Action Item:** We will expand this section on sediment
                - **Clarification**: Dams were not taken down, Eulachon most likely have probably been there in small numbers for awhile but we haven't noticed them

Section 3: Page 15:

- Appendix B will be re-worked to include 2 data sets
- Information on the general approach is provided in Appendix B
- Habitat suitability as bright red, suitable habitat for Eulachon, yet Eulachon don't appear in fisheries as by-catch there
    - Keep in mind, the model is identifying locations that have the same habitat characteristics as where Eulachon are found
    - The review of the model only looks at a specific timeframe and life-stage of the Eulachon
        - Next step is to refine the model for DU specific work
        - Have not seen any evidence of Eulachon adults in the Marine environment. Only time we see adults are in spawning areas.
            - There are a few records of finding Eulachon in the Strait – 1971
            - This heading "Adults" to (Juvinille or Sub-Adult)
            - The egg survey that is going on in the Strait this year is picking up some Eulachon.
            - **Suggestion:** More work is needed on this model on a DU specific basis
            - The model seems to be pre-mature
            - The statistics need to looked and needs to be peer-reviewed
            - **Suggestion:** We can go back to marine requirements and not include any model – it will appear in revised documents
            - The data that has been used and whether it was applied correctly is what is in question
            - **Recommendation:**
                - Outline that work in this document is still underway and in progress
                - Ask what does it add to the RPA? It does show data on where Eulachon have been caught, is important to keep in.
                - Don't take figure 2 out, add wording in to discuss where Eulachon has been found in the marine environment
                - Would be more appropriate to use juvenile catches from researches and in the future use those to model habitat
                - There are some place markers about how long Eulachon are found in the estuary
    - Bella Coola studies found larvae up to 2-3 months in the estuary
    - Pg. 16: There is nothing to compare the generalizations of prey on Eulachon

Section 3.2: Habitat Extent

- Some of this specificity may be the kind of information that goes into the DU report? Will we be replicating in the DU reports?
- There is a trend that there hasn't been a lot of work done on rivers that have good runs – work may not have been done
- Specifics for spawning locations in the river may be specific to the river, not quite sure there is relevance to do this in this paper
    - **Suggestion:** Unless there is anything wrong with what is mentioned here, keep it in and summarize in the DU paper.
    - Maybe use an example of two different systems and habitat extent used. Depends on what rivers you choose.

- Habitat requirement section: Mentions specific flow rates but this level of specificity does not run throughout the paper, getting lost on what you are aiming for in this paper.
- What is the SARA requirement for this section?
    - More information is better for recovery planning
    - **Suggestion**: This section would benefit from the traditional knowledge around it. We encourage getting this knowledge and incorporating it as such in the doc. Add a preamble in this section that further work needs to be done. What is presented here is the first cut, its valid but it is not adequate. Personal communications may be the best way to obtain this information
    - Traditional knowledge has not been solicited very well for this document, particularly the Freshwater spawning critical habitat.
        - **Suggestion:** First sentence say in this section: if you are not going to list all of those habitats – add a preamble of what's done, what's not done, what's next – highlight why it hasn't been explored in this doc

Page 18: Marine

- Strike out Coriolis effect sentence
- Delineating between a juvenile and an adult - will change to "sub-adults" and we will strike comments to the model in this section (model will be removed)

Section 3.3: Pg.19

- **Freshwater**: Configuration of habitat and sandbars may have changed over time and the functionality may not be the same,
    - Last sentence in section: "Thus..."this may be a premature conclusion in this sections, we can't quantitatively identify habitat needs
- Structural issue with the document – should cross-reference this section with the Threats section
- Kitimat River – at least half of the potential habitat is barrier is gone due to obvious barriers like Dams – this comes back to the actual available habitat to meet the needs of Eulachon hasn't been done. When we get to the DU papers will be a place to discuss this in more detail.
    - We can re-work the wording to be very clear on what we do know and be less conclusive and outline that it needs to be explored on a system by system basis
- Structural issue of the layout of the sections – later on under Threats 5.1.25 – Habitat in section 3, introduce environmental shifts like ocean warming
    - Need to look at the services of habitat and the effect on Eulachon
    - Further this work on a DU by DU basis
- **Marine:** We will conclude that we don't know and specify that modelling work is being undertaken

Section 3, 3.4, 3.5: Need the authors to take a step back and keep these sections fairly high level – outline what we know and don't know

- If we don't know what population targets are how can we make recovery targets? It compounds the speculative nature of these sections

Section 3.4: Habitat Restoration

- Only potential for doing restoration is in FW and estuary environments, there is great potential and need to protect and restore FW habitats. Suggestion for restoration is reduce or change that mortality, anything that affects the hydrology and sediment contribution needs to be looked at. **This suggestion will be parked for now**.
- "habitat restoration efforts will result in recovery" – take this out
- Marine:
    - Second sentence: "Eulachon are not known to utilize..." need to emphasize that they are utilizing the marine habitat by foraging.
        - We will incorporate that into this section
    - There have been flooding events in recent years, comment that this could contribute to Habitat restoration section
    - Critical Habitat mention, take out this sentence, and out a sentence to the effect "Critical Habitat has not been identified due to lack of data"

Section 3.6:

- Take out broadcast spawning
- Residence title does not apply to Eulachon

Section 4:

- We lack data, we lack life history characteristics, we don't have the DU status – note something general here, note that further work needs to be done specifically with the Fraser River.
    - We need numbers and benchmarks at some point in time. Need some connection between managing the potential threats will need some management rule.
    - Without monitoring in the rivers, it will be impossible to measure quantitative or qualitative population estimates
        - We will summarize a very general paragraph discussing these data gaps and remove scenario from text, reference the PA, Wild Salmon Policy benchmark purpose
        - May be worth mentioning population movement north (AK) and movement south (Columbia)

Section 5: Scope for Management to Facilitate Recovery

5.1.1.1:

- **Action Item:** Chantal to check the reference to the Klinaklini River Fishery
- **Commercial Fishery**: it would be helpful to have the data on these fisheries, current catch on Fraser and when the fisheries closed, and if no data exists please state that.
- Megan Moody to follow up and retrieve data from Skeena Fishery
- "Directed catch is likely not..." – this sentence is speculative, unless there is evidence to support this statement we can't include. Add a statement saying "we don't know the cause of the decline" and then add a list of possible threats and leave it as facts

- Do we want to just list the threats as possible reasons for the decline of the population? Yes. We have no analysis or evidence indicating one specific threat. Remove any wording that is speculative or conclusive
    - This would be a good place to list non-directed fisheries where there is incidental catch where there is Eulachon mortality
    - It also suggests that the In-River harvest are only happening on the Nass and Fraser – add a general statement referring to table
- There is a section with FN FSC fishers with absolutely no data – the doc needs at least personal communications to support FN FSC fishers

  If you have data it should be presented here
    - If it's not here its b/c we didn't have access to it, we need data from FN, can be found in Megan Moody's thesis
    - **Recommendation:** Authors will work with Megan on making this section as up to date as possible

Section 5.1.1.4: Predation:

- Predation may be a threat to the species but not one we have control over – this is a biological threat
- Do fishery's exist that occupy the same trophic level
- Comment on Harbour Seals increased population – Eulachon research council meeting (2000) it was estimated that the seals and sea lions eat 300 tonnes of Eulachon – estimated by-catch of Eulachon in the Shrimp fleet was 1 tonne – this is a really reaching statement and is not appropriate.
    - The Authors will remove this speculative information/comment

Section 5.1.2.2: Commercial Shrimp Trawl Fishery:

- There are documents that have not been published but have written on by-catch in the shrimp trawl industry – there is no reference to these documents in the paper
    - **Action Item:** Lorne to forward these papers on to the authors
    - By-catch records are catch records for Eulachon - there was a confidentiality policy issue regarding releasing this data
    - The extruders do save Eulachon but they are most likely damaged, does not represent Eulachon stocks
    - Not all of the data is going to have one vessel – need a map produced where by-catch is provided in certain cells – there needs to be some data reported here
    - **Action Item:** Lorne to forward Christina the industry research
- **Recommendation:** Investigate other reports that are available and see how valuable they are in terms of how to quantify this.
- Need to outline the history of the fleet and increase in mid-1990's to give the reader the sense of history with the fish
- History of this Fishery is a crucial issue – need to track the history of this fish and the Shrimp Trawl
    - We could have a section in Threats discussing cumulative effects and synergistic effects on the fish
    - Pg. 34: Also note non-landed fishing mortality – damage to fish in nets

- Part of assessing threats is looking at the data and seeing which threats are bigger than others – need to create a short list of threats (predation, non-landed mortality, etc) to account for the disparity between offshore and freshwater indices.
    - The work hasn't been done to say conclusively that this disparity is real
    - We are not in a position here to take this line of inquiry
- May be able to include annual roll ups in FN fishery and Shrimp Trawl fleet – how do we arrive at these numbers – in season process that any relationship that we have in terms – sometimes we get individual vessel coverage if we receive a report, have 50 days for west coast of Vancouver Island take catch/hour and extrapolate over the total amount of hours – this information is available but has not been peer-reviewed and is unpublished.
    - This data needs to be mentioned somewhere so we can manage this species
    - **Recommendation:** If there is data that can be presented please send it to the authors, if there isn't the Eulachon by-catch data should be peer-reviewed and published.
    - **Suggestion:** Incidental mortality due to interactions with gear needs to be identified as a threat with the fact that you can't quantify this

Section 5.1.2.4: Research Surveys:

- Don't need to compare the relative amount compare to the biomass – take this out
- Do the US reps have any data in Oregon on the Eulachon by-catch rate that is published?
- Washington has not been monitoring of the fishery off the coast – Oregon has, Bob Hannah of Fish and Wildlife
- There are Federal observers in the Oregon and California fishery on the by-catch of Eulachon, paper was published recently
- Paper found fairly significant by-catch, estimated the by-catch in total numbers of Eulachon caught
- Climate Change should have its own section in Environmental Shifts section
- **Recommendation:** Create a graph illustrating the effort of Shrimp Trawl, groundfish fishery and research going back as far as possible in for each fishery to get perspective on which may be more impactful

Section 5.1.2.5: Environmental Shift:

- **Recommendation:** Separate the natural or biotic threats vs anthropogenic threats and climate change as its own threat

Section 5.2: Threats to Habitat:

- There is nothing on threats to marine habitat and if we are going to add the foraging piece on marine habitat then you may want to include changes in oceanic conditions and that impact on prey availability
- Dredging removes sediment and changes hydrology – need to discuss sediment contribution and hydrology – run of river projects
- **Recommendation**: Highlight activities that alter hydrology (Dams, dikes, roads, shoreline construction) etc.

- Climate change is going to affect marine productivity and timing, water temp in FW environment and hydrology – these will influence timing in the estuary – need to be thinking more with a EBM approach and not just at activities
    - Christine to send paper to authors

Section 5.2:1.2: Dredging

- Impact is stated rather definitively and needs to match the rest of the document
- **Recommendation:** Re-word this statement to be less conclusive
- Consider multiple-use conflicts that are taking place in Eulachon habitat
- **Recommendations:** Reference to PAHs should be "Polycyclic Aromatic Hydrocarbon" – please change this, Michael to forward any information regarding PAHs to Chantal and Tom

Section 5: Conclusion

- **Recommendation:** Concluding paragraph will be taken out

Section 6: Scenarios for mitigation and alternatives to activities:

- **Recommendation:** We have listed the threats (not quantified) in this section we are not quantifying the benefit of the mitigation. Can we have some preference here b/c we have not quantified the impact of the threats and thus cannot quantify the benefit of the mitigation – add a general statement that these mitigation scenarios would decrease the impact to the species
- **Recommendation:** Table 6: Include "Will reduce this source direct harvest closer to zero" into the "expected reduction in mortality..." for commercial fishing row.

Section 6.1: Current Mitigation:

- **Recommendation:** Indicate that the Fraser river is the only place where there is a fishery
- **Recommendation:** State that scenarios will need to be developed by DU, remove "Scenarios" from title in section 6
- **Recommendation:** We would like to include more traditional knowledge on tradition catch practices and we are limited on data. In document refer to the fact that FN have their own practices that aren't written down and needs to be mentioned here
- **Recommendation**: Acknowledgement of traditional catch practices – at least a declaration that there is more information out there that goes beyond a IFMP licence. Book mark this here and describe more in depth in the DU reports.
- **Recommendation:** Capture threat to heli-drop zones in regards to freshwater habitat

Section 6.1: Potential Mitigation:

- **Recommendation:** Make the section a bit more clear, needs more structure
- **Recommendation:** Take out the first paragraph on pg. 37 (FN para)
- **Recommendation**: Say further restrictions on closure, or on spawned individuals. May wish to explore traditional methods of conserving spawning biomass.
- **Recommendations:** Take out "could" and "should" words

Section 6.1: Monitoring

- **Recommendation**: By-Catch Monitoring is not mitigation. Monitoring should be a sub-bullet under Eulachon action level
- **Recommendation:** How effective the gear types are on by-catch has not been quantified, add a statement to say what they were developed for and efficacy of the gates has not been published. Grate is proven to be selective to Eulachon by-catch, the snow-fencing may prove to decrease the by-catch of Eulachon.
- **Recommendation:** BRDs – we don't have effective documentation
- **Recommendation:** Need to get the assessment of the by-catch data and EAL in 2000, this was a published DFO document
- **Recommendation:** Need to make sure that a statement for the mitigation scenario's have not been looked at for their effectiveness and cannot make any conclusions from this
- **Recommendation:** Use the language in the RPA protocol (ToR) E. Scenarios for Threats, #21.
- **Recommendation:** timing potential closures for avoiding Eulachon for mitigation measures
- **Recommendation:** Take out the word "intractable" nothing is intractable.
- **Recommendation:** Take out- why we would not adopt these mitigation measures – haven't done this for other sections. State the consequence of closing is that you lack data.
- **Recommendation:** Change the wording around small-mesh surveys

Section 6.2: Mitigation threats to habitat:

- **Recommendation:** Either respond to the threats to habitat or add a preamble that consensus that this section is incomplete and more information needs to be explored. It will be more effective to discuss these measure on a DU basis
- **Recommendation:** For the threats section, need to talk to a Habitat Manager
- **Recommendation:** Indicate in the title of this document to **Part 1**
- **Recommendation:** Committee to review the document again and provide comment to authors by email.

Section 6.3: Activities to increase productivity:

- **Recommendation:** Experimental work has been initiated on the Kitimat River

Section 6.4/6.5: Reduction and Allowable Harm

- Take out of section, cannot discuss
- Recommendation: Need to state that there is a next step on a DU level

Section 7: Assessment of Recovery Potential:

- **Recommendation:** Less threat on individuals

Section 8: Sources of uncertainty and research recommendations:

- Recommendation: change title to sources of uncertainty
- **Recommendation:** This section will be the summary of the document, this section will highlight all of the major gaps

- **Recommendation:** Will take out science recommendations on what should be done
- **Recommendation:** Need to develop genetic markers to separate them out from other smelt
- **Motion to accept the paper**
- Two documents will be coming out of this meeting, a working paper and proceedings doc
- **Recommendation:** Explicit advice on request for a RPA working paper is needed

ACKNOWLEDGEMENTS

The chairperson would like to thank the authors for the hard work and the participants for a constructive review. Thank you to Caroline Wells for rapporteuring. Thank you to Doug Hay and Megan Moody for reviewing the paper. And thank you to Janeane MacGillivray for administrating the webinar and arranging the logistics of the meeting.

APPENDIX A: TERMS OF REFERENCE

Information in Support of a Recovery Potential Assessment for Eulachon (*Thaleichthys pacificus*)

Pacific Regional Advisory Process

March 23 -24, 2011
Nanaimo, B.C.

Chairperson: Sean MacConnachie

Context

When the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designates aquatic species as threatened or endangered, Fisheries and Oceans Canada (DFO), as the responsible jurisdiction under the Species at Risk Act (SARA), is required to undertake a number of actions. Many of these actions require scientific information on the current status of the species, population or designable unit (DU), threats to its survival and recovery, and the feasibility of its recovery. Formulation of this scientific advice has typically been developed through a Recovery Potential Assessment (RPA) that is normally conducted shortly after the COSEWIC assessment. This timing allows for the consideration of peer-reviewed scientific analyses into SARA processes including recovery planning and listing recommendations.

Eulachon will be assessed by COSEWIC in April 2011. DFO Science has been asked to undertake an RPA, based on the National Frameworks (DFO 2007a and b) developed for this purpose. The information and advice in the RPA may be used to inform both scientific and socio-economic elements that are considered by the Minister of Fisheries and Oceans Canada in recommending whether a species is listed as Threatened or Endangered under the Species at Risk Act, as well as development of a recovery strategy and action plan, and to support decision-making with regards to the issuance of permits, agreements and related conditions, as per section 73, 74, 75, 77 and 78 of SARA.

Although the status and reasons for assessment have not been completed by COSEWIC, given the recent declines of eulachon in spawning rivers coastwide it is reasonable to assume that eulachon will be assessed to be at risk of extinction. This working paper will form the foundation for subsequent specific analysis once COSEWIC has assessed risk level and DU structure.

Objective

Taking into consideration available information, and accounting for uncertainties, provide information and advice respecting the potential for Eulachon recovery. The following working paper will be reviewed in support of this objective.

Levesque. C. 2011.Information in support of a recovery potential assessment for Eulachon (*Thaleichtys pacificus*) CSAP (Centre for Science Advice Pacific) Working Paper 2011/XXX.

The provision of recovery potential information and advice is guided by the DFO National Framework (DFO 2007a and b) developed for this purpose. The frameworks outline the following specific elements for the provision of RPA information and advice, and will be used to guide this review.

A. Population status, trends and trajectories

1. Evaluate present Eulachon status for abundance and range and number of populations.

2. Evaluate recent species trajectory for abundance (i.e., numbers and biomass focusing on matures) and range and number of populations.
3. Estimate, to the extent that information allows, the current or recent life-history parameters for Eulachon (total mortality, natural mortality, fecundity, maturity, recruitment, etc.) or reasonable surrogates; and associated uncertainties for all parameters.
4. Estimate expected population and distribution targets for recovery, according to DFO guidelines (DFO 2005).
5. Project expected Eulachon population trajectories over three generations (or other biologically reasonable time), and trajectories over time to the recovery target (if possible to achieve), given current population dynamics parameters and associated uncertainties using DFO guidelines on long-term projections (Shelton *et al.* 2007).

B. Species Residence

6. Evaluate residence requirements for the species, if any.

C. Habitat Use of Eulachon

7. Provide functional descriptions (as defined in DFO 2007b) of the properties of the aquatic habitat that Eulachon needs for successful completion of all life-history stages.
8. Provide information on the spatial extent of the areas in Eulachon range that are likely to have these habitat properties.
9. Identify the activities most likely to threaten the habitat properties that give the sites their value, and provide information on the extent and consequences of these activities.
10. Quantify how the biological function(s) that specific habitat feature(s) provide to the species varies with the state or amount of the habitat, including carrying capacity limits, if any.
11. Quantify the presence and extent of spatial configuration constraints, if any, such as connectivity, barriers to access, etc.
12. Provide advice on how much habitat of various qualities / properties exists at present.
13. Provide advice on the degree to which supply of suitable habitat meets the demands of the species both at present, and when the species reaches biologically based recovery targets for abundance and range and number of populations.
14. Provide advice on feasibility of restoring habitat to higher values, if supply may not meet demand by the time recovery targets would be reached, in the context of all available options for achieving recovery targets for population size and range.
15. Provide advice on risks associated with habitat "allocation" decisions, if any options would be available at the time when specific areas are designated as Critical Habitat.
16. Provide advice on the extent to which various threats can alter the quality and/or quantity of habitat that is available.

D. Assess the Scope for Recovery of Eulachon

17. Assess the probability that the recovery targets can be achieved under current rates of Eulachon population dynamics parameters, and how that probability would vary with different mortality (especially lower) and productivity (especially higher) parameters.
18. Quantify to the extent possible the magnitude of each major potential source of mortality identified in the pre-COSEWIC assessment, the COSEWIC Status Report, information from DFO sectors, and other sources.

19. Quantify to the extent possible the likelihood that the current quantity and quality of habitat is sufficient to allow population increase, and would be sufficient to support a population that has reached its recovery targets.

20. Assess to the extent possible the magnitude by which current threats to habitats have reduced habitat quantity and quality.

E. Scenarios for Threats Mitigation and and/or Recovery

21. Using input from all DFO sectors and other sources as appropriate, develop an inventory of all feasible measures to minimize/mitigate the impacts of activities that are threats to the species and its habitat (Steps 18 and 20).

22. Using input from all DFO sectors and other sources as appropriate, develop an inventory of all reasonable alternatives to the activities that are threats to the species and its habitat (Steps 18 and 20).

23. Using input from all DFO sectors and other sources as appropriate, develop an inventory of activities that could increase the productivity or survivorship parameters (Steps 3 and 17).

24. Estimate, to the extent possible, the reduction in mortality rate expected by each of the mitigation measures in step 21 or alternatives in step 22 and the increase in productivity or survivorship associated with each measure in step 23.

25. Project expected population trajectory (and uncertainties) over three generations (or other biologically reasonable time), and to the time of reaching recovery targets when recovery is feasible; given mortality rates and productivities associated with specific scenarios identified for exploration (as above). Include scenarios which provide as high a probability of survivorship and recovery as possible for biologically realistic parameter values.

26. Recommend parameter values for population productivity and starting mortality rates, and where necessary, specialized features of population models that would be required to allow exploration of additional scenarios as part of the assessment of economic, social, and cultural impacts of listing the species.

F. Allowable Harm

27. Evaluate maximum human-induced mortality which the species can sustain and not jeopardize survival or recovery of the species.

Expected Publications

- CSAS Proceedings of meeting
- CSAS Research Document

Participation

DFO Science, Oceans, Habitat and Species at Risk, Policy and Economics, Aboriginal Communities, Province of BC, External Reviewers, Industry, Non-governmental organizations and Other Stakeholders will be invited to participate in this meeting.

References Cited

DFO. 2005. A framework for developing science advice on recovery targets for aquatic species in the context of the Species at Risk Act. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2005/054.

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APPENDIX B: PARTICIPANTS

Last Name	First Name	Affiliation
Benyon	William	Metlakatla Fisheries
Brekke	Heather	DFO
Brown	Tom	DFO
Cammallang	Abbey	DFO
Campbell	Colin	Sierra Club
Candy	John	DFO
Clark	Dan	DFO
Clayton	Lorne	Pacific Coast Shrimp Trawl Industry
Curtis	Janelle	DFO
Ennevor	Bridget	DFO
Fong	Ken	DFO
Freethy	Diana	DFO
Gillespie	Graham	DFO
Glendale	Fred	Da'naxda'xw Nation/DNT Fisheries
Gordon	Michael	Haisla Fisheries
Gustafson	Richard	NMFS
Hall	Peter	DFO
Hay	Doug	
Henderson	John	Fisheries Council
James	Brad	Wash-Oregon DF&G
Johansen	Jeff	DFO
Joyce	Marilyn	DFO
Kelson	John	Independent eulachon consultant
Kenyon	Robyn	DFO
Levesque	Chantal	DFO
Lewis	Adam	Haisla Fisheries
MacConnachie	Sean	DFO
Magnusson	Gisele	DFO
McCarter	Bruce	DFO
Mijacika	Lisa	DFO
Moody	Megan	
Nyce Sr	Harry	Nisga'a Lisims Government
Plate	Elmar	LGL - Fraser

Last Name	First Name	Affiliation
Rolston	Dave	Kitsumkalum Fisheries
Rutherford	Dennis	DFO
Schweigert	Jake	DFO
Soto	Cristina	North Coast Skeena First Nations Stewardship Society
Stewart	Blair	Nisga'a Lisims Government
Tanasichuk	Ron	DFO
Therriault	Tom	DFO
Watkinson	Stephen	DFO
Wells	Caroline	DFO
Wood	Chris	DFO
Workman	Greg	DFO

APPENDIX C: AGENDA

Regional Advisory Process

Information in Support of a Recovery Potential Assessment of Eulachon (*Thaleichthys pacificus*) in Canada

March 23-24, 2011

Nanaimo, B.C.

Chairperson: Sean MacConnachie

DAY 1 – Wednesday, March 23, 2011

Time	Subject	Presenter
0900	Introductions	Sean MacConnachie
0910	Review Agenda & Housekeeping	Sean MacConnachie
0920	CSAS Overview & Procedures	Sean MacConnachie
0930	Review of Terms of Reference as pertains to research document	Sean MacConnachie & RAP Participants
0940	Presentation of Working Paper	Chantal Levesque
1045	***Break***	
1100	Questions of Clarification	RAP Participants
1115	Presentation of Reviews & Authors' Responses	Reviewers & Author(s)
1200	***Lunch Break***	
1300	Presentation of Reviews & Authors' Responses	Reviewers & Author(s)
1400	Discussion and Building Agreement on Conclusions, Recommendations, Advice and Future Work	RAP Participants
1600	***Adjournment***	

DAY 2 – Thursday, March 24, 2011

Time	Subject	Presenter
0900	Introductions	Sean MacConnachie
0910	Discussion and Building Agreement on Conclusions, Recommendations, Advice and Future Work	RAP Participants
1045	***Break***	
1100	Discussion and Building Agreement on Conclusions, Recommendations, Advice and Future Work	RAP Participants
1200	***Lunch Break***	
1300	Discussion and Building Agreement on Conclusions, Recommendations, Advice and Future Work (If required).	RAP Participants

APPENDIX D: WRITTEN REVIEWS

Review of CSAS Working Paper 2011/P27: Information in Support of a Recovery Potential Assessment of Eulachon

Megan Moody

Process comments

The reasoning behind the timing of the working paper is confusing, as the RPA is usually prepared after a listing recommendation from COSEWIC is either threatened or endangered. Since COSEWIC has not come out with a recommendation for a listing (scheduled for May 2011)... this paper does not clearly state why this RPA has been written prior to a COSEWIC recommendation. This process seems rushed, although this it is unclear why, as the COSEWIC review has been postponed on several occasions as it was initially scheduled for November 2010, and now will not take place until May 2011. I think the timing of this meeting should have been more carefully considered. First Nations are technical experts when it comes to eulachon and they should be heavily involved in any process concerning eulachon. March and April is eulachon monitoring season, thus the experts who would contribute to this process are unable to attend because they are out in the field monitoring eulachon, and although there is a webcast, it is always better to attend in person.

One can only assume that there is a strong expectation that eulachon will be listed and for which DU's (areas, rivers?) remains unknown, as these have yet to be recommended by COSEWIC. So my question is, was it appropriate or useful to come out with an RPA prior to the COSEWIC recommendations?

General Paper Comments:

Generally the purpose of the working paper is clearly stated however, as stated above more clarity in needed on why it is being reviewed prior to COSEWIC recommendations. There are a few unpublished papers that are referenced that would be helpful for the reader to review in order to better understand the reasoning behind their reference.

For example:

Clarke, C.L and Therriault, T.W. 2007 Eulachon Management and Compliance with the Precautionary Approach. Unpublished.

Bryan, M.D. and Christensen, L.B. 2009. Stock Assessment Report: Taking stock of the Fraser and Columbia River Eulachon. Stochastic Stock Reduction Analysis. Fisheries Centre, University of British Columbia. 27p. Unpublished.

The data and methods are explained in sufficient detail to evaluate the conclusions made (which are mostly inconclusive because of lacking data and the obvious question that we don't know why eulachon are declining) but the document needs to present more advice in the way of mitigation and recommendations for future research and explain how these could be achieved.

Future research recommendations:

1. Approximately 7 Rivers systems could be chosen along the BC Coast and monitored (in-river sampling) (Skeena, Nass, Kitimat or Kemano, Bella Coola, Wannock, Klinaklini or Kemano and Fraser)– although funding would be needed and First Nations should be the ones to do the sampling, as most studies are currently being conducted by FN already.
2. In the interim before monitoring studies can be set up coast wide, the fuzzy logic system (Moody 2008) could be used to present, past and current status coast wide. Advice and additional information (e.g. catch, CPUE, larval survey data) could be gathered and used

from all scientists (First Nations, DFO, US, consultants etc.) to update and adjust the system.

3. Offshore research is needed to determine what is happening to eulachon – abundance declining after offshore surveys? After the offshore surveys are conducted, more sampling needs to be done to see 1) where, or are they moving 2) is their mortality high during this time? etc.
4. Baseline DNA is needed for each 'major' eulachon system to compare with offshore survey eulachon DNA
5. Offshore surveys need to be expanded to determine the scope of eulachon offshore habitat or to test Appendix B eulachon marine habitat suitability model
6. Aging studies, in-river and offshore – to determine age classes. Consider changing gear type to capture all age classes.
7. Studies on the preferred substrate and flow for incubating eggs to determine if this is a limiting factor for recovery
8. There seems to be an emphasis on the Fraser River and I understand that this system is considered the most data rich so then maybe this paper should be an RPA for the Fraser River. The gathering of existing information and additional research for the other systems would be needed to create an RPA for them. A recommendation would be to do an RPA for each DU as was suggested by the authors in the Background section of this document.
9. Do a feasibility study to see if it is possible to design an experiment where eulachon can be grown from the egg stage to adult stage in order help determine – survival from egg to larva, preferred prey, growth rates etc.

Specific report comments:

Species information:

- "are no larger than 25cm standard length (SL) and 40-60g in weight" (there are larger eulachon than this found in rivers, for example 74.5 grams on the Bella Coola this year, so this statement should be reworded... e.g. are generally...)

Background:

"In anticipation of a status assessment for eulachon..." – please explain – or does this mean an anticipated listing?

Abundance

Rivers (summary used in the COSEWIC report) could use some formatting to more clearly distinguish between each area. Also, an update to at least 2010 is needed for all rivers mentioned – this could be done by involving First Nations and by developing a standard form for each system to gather basic qualitative information about annual run size.

There is no mention of the eulachon monitoring efforts being conducted by First Nations, which are the only (except maybe the Fraser study) ongoing and most recent scientific research being conducted on the eulachon (i.e. Nuxalk, Wuikinuxv, Haisla and Tsimshian projects).

Habitat requirements

3.2 HABITAT EXTENT

Freshwater habitat

This section is a bit confusing as to the purpose, as stated, "This report is not an exhaustive list of these specific areas by river, rather a summary of known habitats used from published reports."

However, if you are listing the extent of eulachon it would be better to generalize into large and small river habitat extent, instead of only mentioning the Fraser, Kemano and Skeena... for example, a larger river like the Fraser... specific locations, distance within the river. And for example a smaller system... The differences could then be easily compared by the reader. Otherwise a short summary should be made for each 'major' River (9 in BC -meaning data collected or fished), as this information does exist and could be easily added to if it doesn't after discussions with local fishermen and First Nations.

Marine

There needs to be an addition to the statement about how offshore biomass indices are being used currently:

"These indices are a relative index that can be used to compare trends within the same area. The estimates should not be interpreted as absolute numbers and compared among areas (i.e. WCVI versus QCSD)."

Because throughout the paper there are references to these numbers that make comparisons and are used for calculations:

For example:

"The WCVI indices also are a few orders of magnitude higher (thousands or hundreds of tons) then the Fraser River SSB estimates (tens of tons or less)."

The MARINE HABITAT SUITABILITY MODEL was useful and I would be interested to see further results and discussions around the model as stated in the paper:

"As noted previously, this model is being re-run using a broader biological data layer that will be discussed at the peer-review meeting."

3.3 SUPPLY OF HABITAT MEETING DEMANDS

There should be an example given to back up this statement:

"3) there have been no obvious changes in habitat quality since the decline, and in fact, for many rivers freshwater habitat quality has improved."

3.5 HABITAT ALLOCATION ADVICE

Marine

"Clearly, there are risks when it comes to allocating marine waters as specific habitat requirements are unknown." List these risks

Options For Abundance Criteria To Set Population Targets

POPULATION GOALS AND TARGETS

"Finally, the offshore indices are not temporally correlated within river returns. For these reasons it is recommended that offshore abundance indices should not be used to asses individual river

population trends at this time" – what is meant by this? Is this being done? Is it okay to compare offshore indices with in-river estimates?

DISTRIBUTION TARGETS

Much more research would be needed to determine targets for each eulachon river in BC, which is not really feasible (i.e. because of the cost of larval sampling programs and the remote locations of some rivers). However, if approximately 7 Rivers systems along the BC Coast were chosen and monitored (in-river sampling, or catch monitoring program) (Skeena, Nass, Kitimat or Kemano, Bella Coola, Wannock, Klinaklini or Kemano and Fraser)–by First Nations or at a minimum with the involvement of First Nations, a better indication of what was happening coast wide could be known annually. Funding would need to be secured as it is minimal right now for eulachon research.

Options For Abundance Criteria To Set Population Targets:

"In absence of precautionary reference points and harvest rules, the following reference points should be used as provisional elements to assess the stock in relation to sustainability. These include 80% of the biomass which gives maximum sustainable yield (0.8 BMSY) for the USR and 40% of BMSY as the LRP (0.4 BMSY), and the fishing mortality that gives maximum sustainable yield (FMSY) as the maximum RR.

- Please make a comment here that explains that eulachon are not a commercially fished species in Canada (exception Fraser River) as this wording could be interpreted otherwise

5. SCOPE FOR MANAGEMENT TO FACILITATE RECOVERY

Overall, the detail on the background text for commercial shrimp and groundfish trawl fisheries is not adequate in this section as this has been a very contentious issue around eulachon declines and recovery.

5.1 THREATS TO INDIVIDUALS

5.1.2.2 Commercial Shrimp Trawl Fishery

There is no mention of the bycatch estimates during the mid 90's and the history of the shrimp fleet which resulted in the increase in effort during the mid 90's, and eventually resulted in the mandatory uses of BRDs (the use of BRDs is stated but the reasoning behind this is not)

This section does not discuss the threat of bycatch to smaller eulachon populations or depressed eulachon populations as is discussed with the other threats

5.1.2.4 Research Surveys

"The groundfish surveys as a whole are not a large source of mortality relative to the entire spawning stock biomass of eulachon observed offshore." The entire eulachon SSB offshore is a relative SSB estimate so is it fair to make this comment? If the SSB estimations are a minimal estimate, then ok. However, this should be clearly stated in the 1.3.2 section (Abundance-Marine).

6. SCENARIOS FOR MITIGATION AND ALTERNATIVES TO ACTIVITIES

I would have expected this paper to have many more recommendations for management actions and potential mitigation strategies. And also to provide recommendations in a prioritized list for research studies required to improve the RPA or in order to complete a recovery strategy.

Comments

"First Nations fisheries- Further restrictions on First Nations harvest on all rivers where currently occurring or may potentially occur in the future, should also be considered. Both First Nations

and recreational fisheries could be reconsidered for openings when within river spawning eulachon populations reach sufficient densities. If eulachon are listed under SARA, recovery targets selected as part of the recovery strategy could help set densities required, at a given location, before harvesting opportunities are considered."

- This would require need increased monitoring efforts or monitoring to even set targets.
- All measures taken by shrimp trawl industry to reduce impacts to eulachon are listed in that impact section but there is no discussion about FN efforts to protect and survey eulachon – this needs to be added

"a. The EAL is set for the present year at 1% of the eulachon biomass index estimated during the multispecies small mesh bottom trawl survey for the WCVI from the previous year to a maximum of 20 tonnes combined for SMAs 124OFF and 125OFF and 20 tonnes combined for 23OFF, 21OFF and 23IN. The EAL may be adjusted in season based on 1% of the eulachon biomass index from the present year small mesh multispecies survey (DFO 2010c)." Again it is not clear why this SSB relative abundance # is used for management to set the EAL – or is this taken into consideration? Can you clearly state the reasoning here or in the 1.3.2 section (Abundance- Marine). "Continued evaluation of the effectiveness of any measures used to reduce eulachon bycatch will be required to quantify and monitor potential reductions in eulachon mortality."

- No other recommendations are given for this section, only a list of what has been done, has been provided. This is surprising because the recommendation of "further restrictions" is to be considered for directed eulachon fisheries. The same recommendation of "further restrictions" could be made here, as the precautionary approach is to be taken.

The argument for the offshore research surveys to continue is stated:

"Reduced effort would further increase uncertainty making it even more difficult to understand the marine to freshwater dynamic in the eulachon's life history."

The same should be mentioned for reducing the effort of in-river eulachon monitoring projects in the

6.5 SCOPE FOR ALLOWABLE HARM - *All Rivers*, section

The validity of larval sampling in rivers other than the Fraser River needs to be researched more. As this statement was made:

"However, this method has only been validated for the Fraser River and its applicability to monitoring other rivers will need validation."

- There are very good sampling programs, although limited, occurring in BC systems other than the Fraser. The Bella Coola River is a good example, 10 years of sampling.
- Again there is no mention of the eulachon monitoring efforts being conducted by First Nations, which are the most recent scientific research being conducted on the eulachon (i.e. Nuxalk, Wuikinuxv, Haisla and Tsimshian projects).

7. ASSESSMENT OF RECOVERY POTENTIAL

"At present, most in river populations are at precariously low levels."

- There is limited discussion in this paper about the runs that are doing well, the Nass and the Skeena over the past two seasons – again the need for the DU's and recommendations for listing on specific DU's.

FIGURES

A size (length) chart for Queen Charlotte Sound offshore eulachon would be useful to include Figure 2 is useful, new information presented.

Figure 5a – shows the early QCSnd surveys – prior to 1998? Were there differences in the methodology for these surveys and are they comparable to those from 1998 to present?

- Also indicate in the legend that no excluder was used or that one was used, in addition to the reference in the title.

Figure B-3- Good information. It would be interesting to show the catch information in shrimp and groundfish (each separately) trawls layered over this map, to see how they compare.

TABLES

Table 6. *List of known and potential anthropogenic and natural sources of morality to eulachon...*

"Potential mitigation and/or alternative to activity column"

Why is the Nass included under the FN fishery if it is considered a stable run –and reduce the catch to zero? Or are all runs that have FN's catches to be included? If so, more clarification is needed and other rivers would need to be added here.

Commercial fishery bycatch – why would this not be decreased to "almost zero" as well.

Review of CSAS Working Paper 2011/P27: Information in Support of a Recovery Potential Assessment of Eulachon (*Thaleichthys pacificus*) in Canada.

Doug Hay, March 20, 2011

Preliminary 'pre-review' comments – the process versus the paper

This page is not part of the review – but summarizes some comments that I would make if I were at the meeting. As I will not be able to attend this meeting I tried to compensate by preparing a long, detailed review. I apologize for the length of this review that begins on the next page.

According to the front page template, CSAS reports "are not intended as definitive statements on the subjects addressed but rather as **progress reports on ongoing investigations".** Based on this statement it is not clear that the CSAS series is the appropriate vehicle for the information in this document because the working paper under review is not a progress report '*of ongoing investigations*'. If this draft (Working Paper 2011/P27) were confined to a progress report of ongoing DFO investigations on eulachon it would be much shorter and not include a lot of material that has already been presented elsewhere, in previous DFO reports and in the current COSEWIC draft.

It is puzzling why this document is intended to precede the forthcoming COSEWIC paper that will be examined by the COSEWIC sub-committee on marine fish in June. The decisions of COSEWIC could render moot much of this working paper, or alternately require much more work to produce a DFO recovery plan that matches the COSEWIC decision. As the timing of the COSEWIC meeting is only a few months away, it would seem sensible to begin the preparations that have gone into this working paper but delay the final presentation of the working paper until the COSEWIC decisions are announced. At such a time a working paper could better respond to the COSEWC decision. The point is that it is not clear why this report is being prepared – in an apparent rush – at this time.

General comments

It is not clear if the substance of this paper provides a sufficient basis for the development of a recovery strategy. There are two aspects to this: one is a reflection of the worth of the paper and the quality and presentation of the work that went into its presentation; the second concerns the state of knowledge about eulachon and whether we are presently able to make credible and useful plans.

In general the authors have done a good job of re-assembling and up-dating information on eulachon distribution, biology and habitat issues but the report stops short of making useful plans, either for research or mitigation. This is an important omission because it probably should be the main objective of the paper. It is difficult, however, to recommend solutions when we do not understand the reason for the problem – which is the eulachon decline. It is clear, nevertheless, that there is a conservation problem because eulachon runs in most rivers have either stopped or declined precipitously. It also is clear that the problem is mainly concerned with eulachon in the marine environment. This statement is based on the near-synchronous decline in many different rivers. The likelihood of this occurring as a consequence of 'in-river' habitat issues is very low. Freshwater habitat issues, as factors affecting eulachon, should not be ignored but they do not deserve the prominence that they receive in this report. Presumably the organization of this report is based on a pre-determined template designed for all organisms but it seems poorly suited for eulachon. A consequence of this 'one-style fits-all' template is that freshwater habitat issues appear to be over-emphasized at the expense of events occurring in the sea. It is unfortunate that authors were not able to channel their resources to spend more of their time examining factors in the marine environment that might be affecting eulachon.

There is an additional but fundamental aspect of the eulachon issue that has not been addressed directly in this working paper. That is the extent to which the decline in eulachon could partially represent a change in distribution of spawners, to rivers or locations where they are not detected. This suggestion might sound heretical to some. Undoubtedly present eulachon abundance is much lower than the past and is obviously in a dismal state, but perhaps not quite as dismal as would be indicated by the negligible returns seen in spawning runs in nearly all BC rivers, and especially those in the central and northern coastal areas. The reason for this assertion is that there is a striking disconnect between the apparent abundance of eulachon at sea, where the abundance is *measured* through systematic surveys and the phenomenally low returns in the rivers. We see thousands of tonnes of eulachon offshore and only a pittance in the rivers. How can this be? Genetic analyses of mixed stocks (Beacham et al 2005) indicate that most of these eulachon are derived from the Fraser. These marine eulachon must come from somewhere and I suggest that we can not rule out the possibility that eulachon spawning areas may have shifted and that there may be areas where eulachon are spawning but are undetected. The survey efforts of First Nations researchers working in the vicinity of the Bella Coola River, the Gardner Canal rivers, the Skeena River and sometimes in other areas are the only current survey efforts dedicated to searching for spawning eulachon north of the Fraser. These efforts are commendable but limited temporally and geographically. DFO field activity in rivers is limited to a short survey on the Fraser River – and even this depends on the laudable efforts of a few people in DFO Science to keep it going while working on a budget of about $8K/y. In short, we really do not have a solid understanding of the spawning distribution of eulachon but we do know that they are not spawning in many of their traditional places and that with the exception of the Nass River, most eulachon spawning runs are greatly diminished relative to the past.

Another general comment on the paper, in the context of the COSEWIC review process, is that the intentions (conservation and recovery) are valid but the template for this working paper is cumbersome. Consequently the purposes of the paper are sometimes obscure and

recommendations seem vague or undeveloped. The paper devotes a lot of space to freshwater related habitat issues, but relatively little on marine issues, apparently following a document template. In general these parts are done well, but there is inadequate treatment of the next step – which is a discussion of recommendations for future research requirements, management actions and potential mitigation.

Finally, it is obvious that a lot of work went into this report but the present draft seems to have been prepared in a rush. There is no abstract. The form of sub-headings vary: some have numbers and others do not. The reference list in incomplete. Some key parts of the text are based on two unpublished reports that are not accessible. In the last section of the paper (Part 8) the text changes into bullet lists without explanation. These relatively minor deficiencies can be repaired but some larger issues, related to the fleshing out of research and management plans, will take more work to correct.

RESPONSES TO THE MAIN REVIEW QUESTIONS

IS THE PURPOSE OF THE WORKING PAPER CLEARLY STATED?

Almost, but they seem to be in the 'Background' section (page 1).

ARE THE DATA AND METHODS ADEQUATE TO SUPPORT THE CONCLUSIONS?

This question is not strictly applicable because this is a review paper.

ARE THE DATA AND METHODS EXPLAINED IN SUFFICIENT DETAIL TO PROPERLY EVALUATE THE CONCLUSIONS?

When data are presented, as in the lists of rivers, etc., it is detailed and clear.

IF THE DOCUMENT PRESENTS ADVICE TO DECISION-MAKERS, ARE THE RECOMMENDATIONS PROVIDED IN A USEABLE FORM, AND DOES THE ADVICE REFLECT THE UNCERTAINTY IN THE DATA, ANALYSIS OR PROCESS?

No. This aspect of the paper requires revision.

CAN YOU SUGGEST ADDITIONAL AREAS OF RESEARCH THAT ARE NEEDED TO IMPROVE OUR ASSESSMENT ABILITIES?

A number of suggestions are made in the review.

Detailed comments

Minor editorial comments – Some are provided separately on a marked draft.

Abstract – missing?

Species information – The text requires a qualification about 'suspected' eulachon occurrences in rivers (see Table 1 and Figure 1). The term 'suspected' and 'probable', as it is used to described eulachon spawning distributions (i.e. Figure 1 and on the text) is misleading. There are rivers where an eulachon presence (either continuous spawning every year or intermittent) is 'suspected' to occur sometimes but it is certain that such suspected spawning does not occur in all years, as in the Squamish River. In many of the rivers designated as 'probable' in Figure 1, it is 'probable' that spawning occurs in them in some years but not probable that it occurs every year. This should be clarified.

Perhaps the significance of these spawning distributions is that the 'probable' are generally closer to the sea than most of the 'confirmed'. Therefore if there has been a general shift in eulachon spawning distributions, then there could be (or have been) a tendency for a general shift to either more downstream locations in rivers (or less penetration to upstream spawning

locations) and a corresponding tendency to spawn in rivers closer to the openings of large estuarine inlets and fjords.

Background – There is more information in other reports than is contained here. It does not seem sensible that this document should attempt to re-assemble all available information about eulachon BUT it could provide a more complete synthesis or review of such information.

1. Status and Trends

1.1 Range

1.1.1 Freshwater – This section is brief but mainly fine. Why does this section not include reference to adult stages plus the egg and larval stages – when the next marine section does that? The paper could point out that in some rivers (and perhaps all) the specific spawning sites (where eggs are released) may change among years (see PSARC reports for the Fraser River).

The implicit significance of these spawning distributions is that the 'probable' are generally closer to the sea than most of the 'confirmed'. Therefore if there has been a general shift in eulachon spawning distributions, then there could be (or have been) a tendency for a general shift to either more downstream locations in rivers (or less penetration to upstream spawning locations) and a corresponding tendency to spawn in rivers closer to the openings of large estuarine inlets and fjords.

1.1.2 Marine – This section is fine but under the juvenile section it might be pointed out that there is evidence that juvenile eulachon are found in Barkley Sound (See Hay and McCarter 2000).

Under the 'Sub-adult stage, the comments about age (third paragraph, bottom page 3) need minor revision and clarification.

1.2. Population structure - This section is reasonably good. A possible weakness is that the micro-satellite DNA study may deserve more attention or emphasis because it is the most definitive. A suggested revision is to use numbered sub-headings, as per section 1.1. This is needed because the beginning of this section mentions five approached to population structure – and this is followed by seven paragraphs. It would seem reasonable to adapt some of the tables and figures used in the Beacham et al (2005) paper into this section.

1.3 Abundance

1.3.1 Rivers - The description for each river is fine although it is mainly a reiteration of information in the COSEWIC report. However, the inclusion of new or more recent information is good.

1.3.2 Marine - This section is too short and misses some vital information.

Figure 2 is excellent, Figure 4 is not. Figure 4 contains three (unlabelled) panels and none has adequate information. Most (>95%) of the life of an eulachon is spent in the sea, so this topic/section is important.

Figure 4 requires more explanation and clarification. There are published DFO reports that explain the derivation of the marine estimates of abundance in research shrimp trawls and these should be cited. As it stands, these two panels are supported only by reference to a DFO website, and that is not adequate. The third panel (unlabelled c) is from a DFO Technical report that examined a short time series on the incidence of eulachon in groundfish trawls (Sinclair et al. 2007). Most readers would conclude from Figure 4 (Panel C) that the eulachon biomass in Hecate Strait is increasing. It may be, but the data presented in panel C are actually CPUE estimates and the geographic area from which these estimates are made, shown by Sinclair et al. (2007) as the "proportion of survey area" varies among years. One way to examine the utility

of these temporal trends is to compare them with independent estimate of spawning biomass. When this is done for herring (using Figures 12 and 13 from Sinclair et al. 2007) and comparing the trends with the most recent herring stock spawning biomass estimates (from Cleary and Schweigert 2012) there is no correspondence: herring biomass decreased in all areas adjacent to Hecate Strait but the CPUE index of Sinclair et al. (2007) increased sharply. Therefore if the CPUE index trend does not reflect trends in herring biomass, then its utility for describing trends in eulachon abundance is not necessarily reliable.

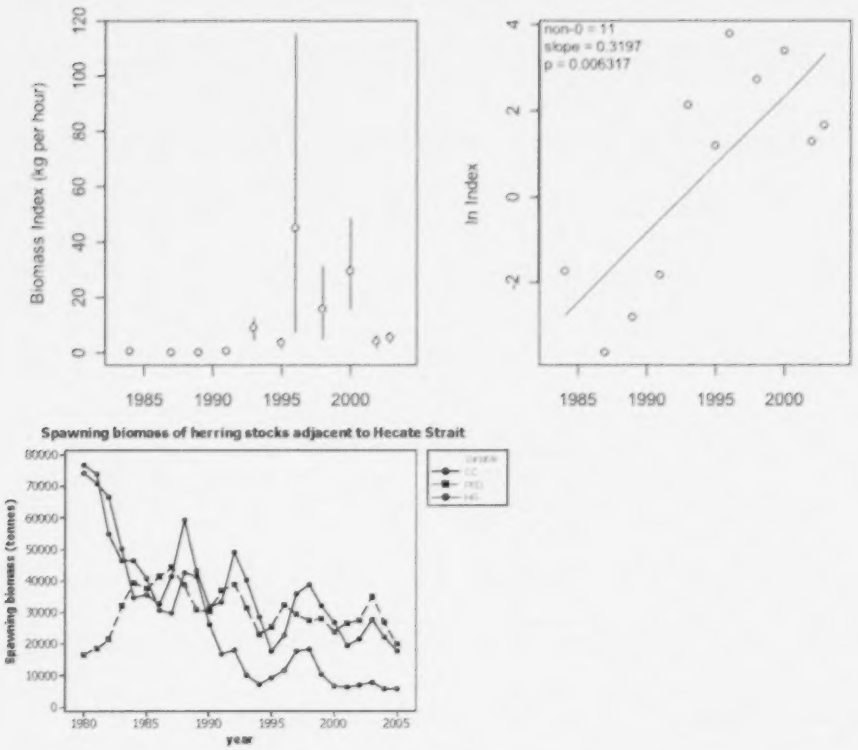


Figure D.1. The two top panels show CPUE estimates for herring (Fig. 13 from Sinclair et al. 2007) which can be compared with spawning biomass estimates for the three herring populations (bottom panel) adjacent to Hecate Strait using data from Cleary and Schweigert 2012.

There are other aspects of the text in this section (1.3.2) that should be presented more carefully. For instance the brief discussion about possible overlap of lengths in adjacent cohorts refers to a DFO website (cited as DFO 2010g) but this website may not have it right either. If the authors want to discuss these subjects – and they should – they need to incorporate the data and figures from these websites and discuss them adequately.

In the final paragraph of this section it is puzzling that the authors cite an unpublished paper that examines time lags between offshore and river indexes of abundance – but fail to cite a peer-reviewed paper (Hay et al. 1997) that does the same thing! It does not really matter, the results are the same.

2. Life History Parameters

Perhaps some Alaskan eulachon do survive after spawning (there is no evidence either way) but the evidence based on tooth loss (or resorption of teeth) seems solid for BC eulachon. It also should be noted that some fish may retain a few teeth as they spawn, but when such individuals are examined closely it is only a few teeth that are retained. It is possible that these represent teeth that are loose and that have lost a vascular connection to the fish, so resorption of calcium cannot occur.

The discussion of semelparity did not include reference to potential latitude variation in semelparity, specifically that semelparity may allow some iteroparity in higher latitudes, as occurs in some other species. However an extended discussion of this could be too arcane for the present report which ideally should focus on recovery issues.

There should be some explanation of what is meant by a 'stock reduction analysis' (second to last paragraph in this section (page 13). The discussion in this paragraph, and the reference to the unpublished report (Bryan and Christensen) should be clarified, because it is not very informative. Perhaps this unpublished report should be included as an appendix of this document if it is useful.

The final paragraph in this section, again, is not informative. It is not helpful to recommend approaches to 'future attempts' when the present attempts are not presented. Perhaps the authors should consider deleting reference to this unpublished document – or include it as part of this document and explain it properly. There seems to be little useful information in Table 3, and inadequate discussion of the contents. Further, it seems that the estimates of relative fecundity are not consistent with those used for SSB estimation in the Fraser.

3. Habitat Characterization

The authors have done a good job of filling in the blanks for this section but it is a concern that 'habitat' has such a prominence in this report, presumably because it has a prominence in the template for this document. The concern is that the decline of eulachon is almost certainly **not** associated with deteriorating habitat, at least in their freshwater phase of their lives. Habitat issues should not be dismissed but there is a risk that some readers will interpret the relatively large amount of space devoted to freshwater 'habitat' (relative to marine issues) as a reflection of the concern that habitat warrants. However if there is a solution to eulachon problems almost certainly it will not come from tinkering with their freshwater habitat. The authors know this as say as much in a different section under 'industrial pollution', (see following text extracted from page 31)

> "Eulachon have been exposed to pollution within the Fraser and Kitimat Rivers for considerable time before their sharp decline occurred in the mid 1990's. Other rivers with minimal pollution, such as the Kemano, Bella Coola, and Wannock Rivers also have suffered declines. Thus, industrial pollution is likely not the sole reason for a synchronous decline among rivers. However, it may be a contributing factor within rivers but the magnitude is uncertain (Pickard and Marmorek 2007)."

Under the section 'Marine' Adults (page 15) there is a reference to Appendix B. Appendix B has some limitations (as mentioned later) but this section seems an obvious place for the information presented in Appendix B. Why would the authors not consider incorporating Appendix B into the main part of the text of this report?

Note – at this point in this document the organization has become extremely confusing because the term 'marine' (and other terms) pops up repeatedly under different sub-

headings. This problem would be solved by making consistent use of numbered sub-headings, that are used in some but not all sections.

If most readers are like me, then they will stumble over the subtleties associated with the many different ways that 'habitat' issues are organized in this section of the paper (and again I assume that the authors had little control over this – because it seems like an organizational template more suitable for a songbird or a mammal, but not a migratory marine fish). Consider that after habitat characterization, there is

1. habitat requirements,
2. habitat extent
3. habitat supply and habitat demand
4. habitat restoration advice and
5. habitat allocation advice.

Candidly, this section makes for difficult reading, with these five+ ways that 'habitat' categories. This organizational structure may lead to obfuscation of the main issues.

How much latitude the authors have to adjust this organization? If possible I recommend a shorter summary of this stuff in a matrix table accompanied by a text summary that avoids repetitive discussion of life stages. If this organization of this section was actually conceived by the authors, so that they are free to revise and change the organization of this section of the report, then I recommend drastic revisions and re-organization and re-write of this section.

4. OPTIONS FOR POPULATION AND DISTRIBUTION GOALS AND TARGETS

POPULATION GOALS AND TARGETS *(why is this heading not '4.1'?)*

Is there a difference between a goal and a target – as the terms are used here?

This is the first paragraph to point out the discrepancy between offshore eulachon abundance and the low river returns but it does not go far enough. Using the Fraser as an example, the offshore abundance is 50-100 times greater than that of the Fraser. This is phenomenal. It indicates that something is happening that we do not understand – and we will not understand it unless we look. Therefore this report should say something about that in the form of research recommendations.

This section makes an odd recommendation: "*Finally, the offshore indices are not temporally correlated with in river returns. For these reasons it is recommended that offshore abundance indices should not be used to asses individual river population trends at this time.*" Offshore indices are not used in this way at the present time, so this recommendation seems spurious – but this is a minor point.

More important issues are raised in the remainder of this section relative to terminology for fishing including definitions of USR, LRP, RR, B_{MSY}, F_{MSY} and an undefined LFP. This terminology-rich section may create unintended problems because it inadvertently links 'recovery' to 'commercial fisheries'. There is a sentence on page 23 that reads as follows: "*The LRP and the USR could be short and long term recovery targets that result in opportunities for sustainable fisheries*".

The only commercial fishery for eulachon in BC was on the Fraser and even this was contentious among First Nations. This paragraph should be revised to make it clear that these concepts are related only to criteria for recovery goals and not to the future establishment of widespread commercial fisheries for eulachon when they recover.

Page 23: **All Rivers**. First sentence. Is the statement that the Kitimat River had virtually no run correct? There was a report of a good run in the Kitimat River in 2010.

5. SCOPE FOR MANAGEMENT TO FACILITATE RECOVERY

This section begins by stating that there are many hypotheses for the eulachon decline. Actually there are not that many and this would be a good place to list and discuss them. This section seems to restart the numbered sub-headings and that is useful if this organization template cannot be changed.

The text on First Nations, commercial, and recreational fisheries is fine. This is followed by a longer discussion on predators and this too is fine although it seems that the subsequent discussion on commercial shrimp and groundfish trawl fisheries is too brief, especially because these have received considerable attention in the past relative to eulachon issues. I recommend that these sections be expanded substantially. As a guide I recommend beginning with the inclusion of some pertinent text that is in the 2010 DFO IMFP for shrimp – which has some of the best and most candid explanation for the origin, development and present status of the present shrimp fishery that I have seen. Such an overview may be useful for inclusion in this report, perhaps as an appendix. For the convenience of readers I have copied the salient parts of this text into the following (in smaller bold font):

From the DFO 2011/12 Shrimp Trawl Integrated Fisheries Management Plan Page 3 of 40

History

A detailed history of the commercial shrimp trawl fisheries, showing landings by management areas, catch ceilings, opening and closure dates, number of participants, numbers of licenced vessels, values and occurrence reports is contained in the annual Shrimp Fishery Reviews. A history of the annual catch ceilings, landings and the assessment of inshore shrimp stocks is available in preparation (DFO 2010).

The first records of trawl nets being used for commercial shrimp fishing date from 1895, but the fishery did not develop in earnest until the 1960's with the use of efficient bottom trawl gear and the exploration and discovery of major shrimp grounds. The history of trawling for shrimp in BC comprises an historical phase from the 1930's to the 1980's, a brief period of increasing participation, maximum effort and high landings in 1995 and 1996 when most of the major shrimp grounds were fished, and a declining phase with stock assessment and full fishery management control, starting in 1997 (Figure 1).

The Shrimp Trawl fishery off the Pacific coast developed in earnest in the 1960's when there was a downturn in the salmon and halibut fisheries and the coast was explored for shrimp beds, and there were incentives to vessel improvement and to increase processing using mechanical peeling machines. Licences were available for any commercial fishing vessel with areas open seasonally with no catch ceilings. The shrimp beds off the West Coast of Vancouver Island were first surveyed in 1972 and a survey has been conducted annually since then. There was shrimp fishing offshore by US vessels, who landed the majority of the catch in US ports. By 1975 and 1976, rapid expansion of the fishing and processing capacity directed at offshore Tofino shrimp stocks lead to licence limitation and eligibility was restricted to those vessels with landings in those two years with 237 vessels qualifying for licences and 71 for Northern area permits. Once licences were finalized, a total of 249 S licences were issued, approximately 171 were otter trawl and 65 beam trawl with vessel length restrictions on transferability. This increased effort was not sustained beyond a few years, however, as the stock declined to the point where it could not support a large offshore trawl fleet. The

reasons for this decline are not known, but do not appear to be linked to the fishing pressure on the stocks.

In 1978 the Tofino and Nootka beds were surveyed and the definition of the 200 nautical mile Exclusive Economic Zone eliminated the US vessels. Significant shrimp landings were made by larger vessels (average 15.8 m) fishing offshore areas with otter trawls (trawl nets with doors that hold the net open). Smaller beam trawl vessels (average 11.1 m), using a hollow beam to keep the net open, fished the inlets and more sheltered waters.

Shrimp biomass has fluctuated significantly in offshore areas and fishing effort may have had some impact on the annual production prior to assessment of offshore stocks in 1975. Few management and assessment programs for the commercial shrimp by trawl fishery were in place prior to the 1990's and the fishery was generally open year round without catch limits, except for West Coast Vancouver Island where surveys were used to set catch ceilings since 1972. Fluctuations in biomass have resulted in boom and bust cycles. By the 1980's the offshore fisheries ceased due to depressed stocks, then started up again in 1987. In the mid 1990's there was a dramatic increase in effort and landings in the commercial trawl fishery. Reduction in the number of salmon licences through a buy-back program (Mifflin Plan)1 resulted in approximately 100 vessels with only shrimp licences. These vessels then could only be used for shrimp by trawl and a few minor fisheries using their Schedule 2 privileges or personal licences to engage in commercial fishing. High shrimp prices and low salmon fishing opportunities in 1995 resulted in increased interest in fishing shrimp. In response to the increase in effort and landings, significant changes in the management of the shrimp trawl fishery were implemented in 1997. Fisheries and Oceans Canada was moving to more precautionary management and risk averse principles and promoting selective fishing practices. The establishment of total allowable catches (TAC) for most areas, a seasonal opening for the offshore pink shrimp fishery and the development of industry-funded programs to monitor catches and contribute to stock assessment were implemented.

As the Northern Shrimp fisheries in Newfoundland and Labrador expanded, supplying cooked and machine peeled, frozen-at-sea or land-based processed cocktail shrimp to the North American market, the economics of the Pacific fishery declined. The number of processors in BC using machine peelers declined until the last machine peeler was taken out of operation in 2006. In the late 1990's few of the otter trawl vessels in BC continued to be active in the fishery. Smaller vessels with beam trawl nets continue fishing inshore in less exposed areas; however, current participation is fewer than 50 vessels and continues to decline.

5.1.2.5 Environmental shifts

It is good that this topic gets some coverage in this document but I recommend that this section could be expanded substantially – because it may very likely account for much of the explanation for the changes we have seen in eulachon. There is a rationale for examining this aspect much more thoroughly in the present report and such an effort would be endorsed by the DFO document on recovery approaches (the pertinent text is copied below).

> **DFO. 2005. A framework for developing science advice on recovery targets for aquatic species in the context of the Species at Risk Act. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2005/054.**
>
> There is growing interest in natural productivity regimes. Where these are documented to exist, the recovery plan usually will have to address the possible levels of system

productivity. The recovery targets for abundance and range should be high enough for the population to be considered secure during the plausible worst-case productivity regimes. The projected time for recovery will also have to take account of the typical durations of different productivity regimes, and the time necessary to achieve recovery targets will be highly uncertain. The expected path to recovery should include periods when there may be little potential for population increase, even if management is exerting control over all sources of mortality that are subject to management regulation. During low productivity regimes, management should be exceptionally risk averse relative to potential harm to listed species or populations. Even with risk averse management, however, population growth to overall recovery targets may not be achievable during low productivity regimes. Then the question of whether the low productive regime will eventually be replaced by a higher productive regime becomes crucial to planning. If the change to low productivity is considered permanent, then a recovery target appropriate for the new productivity characteristics of the species should be sought. If a regime change to higher productivity is expected in the future, then the recovery target should be appropriate for those productivity characteristics, with the Recovery Plan allowing for periods when little progress can be made towards the target and management must focus on keeping the population in a state where it can take full advantage of improved productivity when the regime

There is literature that supports the contention that the changes in eulachon are associated with regime change. In particular the rise and decline of the shrimp fishery in the Gulf of Alaska shows that some marine fishes, including the capelin (also an osmerid) fluctuated in concert with shrimp. The paper by Anderson (2000) is available online. The text of the paper explains that relative capelin abundance, as reflected in CPUE data, are also changed by almost a factor of 10 during the regime shift.

To date there is no paper that attempts to examine changes in eulachon abundance as a consequence of climate variation. This present working paper could attempt to do this briefly. A good starting point would be the changes in shrimp landings observed in BC, as shown in Fig. 1 of the DFO IMFP for 2010 (coped below).

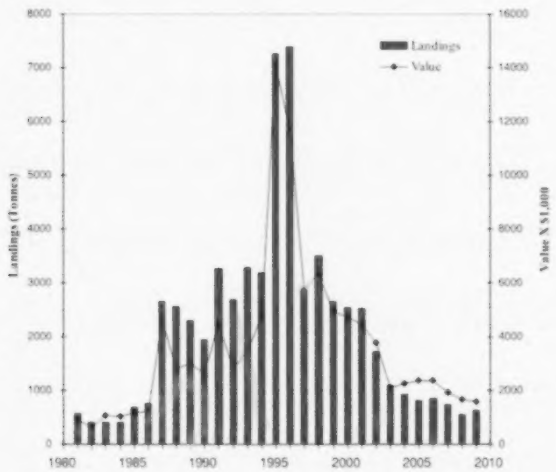


Fig. 1. Landings (tonnes) and Value of the BC Shrimp Trawl Fishery, 1981 to 2009.

Figure D.2. Shrimp landings in British Columbia from DFO IMFP for 2010.

An interesting aspect of the preceding figure (from the DFO 2010 IFMP for shrimp) is that it explains that record catches were made in the mid-1990's. It seems remarkable that 1994 was the year when Fraser River eulachon fishermen first noticed a decline in eulachon and brought this to the attention of DFO. The approximately synchronous decline in shrimp from the mid-1990's to the present time does not necessarily mean that they were over-fished, but instead it also could reflect a decline in response to changing ocean conditions. Similarly, although there can be significant bycatch of eulachon in shrimp trawls, the widespread decline of eulachon, approximately at the same time and in many river systems does not necessarily implicate (or exonerate) the shrimp fishery as a causative factor. Instead it may simply mean that whatever caused the long-term decline in shrimp may also affected eulachon, both in terms of their abundance and distribution and possibly other factors, such as size-at-age, maturity schedules, etc. .

In my view the working paper would be more credible with an expanded discussion of all aspects of trawl fisheries and climate change issues.

5.2 THREATS TO HABITAT

This section is fine but it bears repeating that the collective evidence is that habitat issues are not the cause of the eulachon decline. Although it may be useful to list such habitat issues, it should be made clear to readers that, except for 1-2 rivers, this would not be a productive way to proceed with recovery strategies.

6. SCENARIOS FOR MITIGATION AND ALTERNATIVE TO ACTIVITIES

If there is a single point in this section that warrants more attention and explanation it is the efficacy of BRD's. First, the shrimp fishery should be commended for their pro-active attempts to deal with bycatch by voluntarily incorporating these devices into their gear. Further, they have tried to examine the efficacy of these but without any assistance from DFO. Nevertheless the effectiveness of BRD's at reducing eulachon bycatch is not in doubt – but what is less certain is the condition of eulachon after they emerge from such devices. Are they injured and if so do they survive? These questions are based on research that has examined the survival of small fish (such as herring and other species) that are entrained but not retained in trawls. There is evidence that such encounters cause substantial mortality – a form of 'collateral mortality' related to fishing. The most important issue related to BRD's is whether there is a high incidence of collateral mortality.

7. ASSESSMENT OF RECOVERY POTENTIAL

I would have used a different approach to this question. It is important to realize that eulachon have been around for millions of years and persisted over successive glaciations, when climate change must have been substantial. It is also important to point out that eulachon are in the most trouble in the southern part of their range, like many other anadromous species. This pattern is consistent with the hypothesis that a regime change and/or climate change has impacted eulachon, like it has other marine species, especially anadromous species. Therefore, given that eulachon have been impacted by regime change, the potential for recovery may depend on whether their present decline is part of a long-term permanent change or part of a shorter-term 'regime change', consistent with a pattern of regular temporal fluctuations, as described by Anderson (2000) and maybe roughly similar to those seen in some other small forage species like sardine and anchovy. If the present demise of eulachon has been associated with such a fluctuation in the ocean climate (i.e. classical 'regime change') then it seems possible that the regime may once again change to a form that may be beneficial to eulachon, and the time scales for such change seem to be counted in decades. On the other hand if the difficulty eulachon are experiencing is caused by the more gradual but uni-directional

warming of the ocean climate, then the prognosis for eulachon in BC, and all areas south, is poor indeed and recovery efforts probably will be in vain.

8. SOURCES OF UNCERTAINTY AND RESEARCH RECOMMENDATIONS

This section needs work. It may be the most important section of the paper but it is not well developed and not acceptable in its present form.

Probably the single most important information gap is whether there are unrecognized spawning areas that might account for the sustained presence of eulachon in the sea when there appear to be insufficient spawning biomass in the rivers to account for them. This could be addressed by synoptic larval surveys (see McCarter and Hay 1999).

Another vital gap is the efficacy of BRD's, as mentioned previously in this review

The working paper recommendation about determination of life history parameters is fine, but meaningless unless some eulachon are actually captured and examined. This simply means that sampling of adults must be re-established in the Fraser River as well as other rivers.

There are many other things that might be done some and some are relatively simple and inexpensive. For instance, does anyone really know how much eulachon marine habitat is impacted by trawlers of any type? Table 4 indicates that is most years there are 20-30,000 hours of trawling on the BC coast, and sometimes much more. I believe that there are coordinates for most of these trawl sets, so it may be possible to estimate to total coastal area covered by trawling each year by estimating the lead-line width and the trawl velocity.

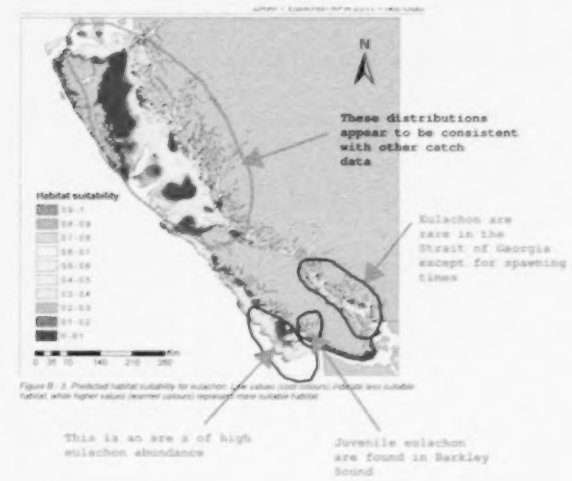
This sum of the bottom area (in cumulative square km – adjusting for location that which could be trawled on repeatedly) could then be compared with the marine habitat area estimated by using approaches similar to that complied by Jessica Finney in Appendix B. This would provide a guide to how much of the potentially available habitat (based on the approach made by Finney) would be exposed to trawling. Then some further modeling could be done using different scenarios of entrainment rates and survival of eulachon that escape from trawls after entrainment. The result may be trivial, but perhaps not.

APPENDIX TABLE A

This table appears to have been extracted from the interim COSEWIC draft? If that was the source, it should be acknowledged.

APPENDIX B: EULACHON MARINE HABITAT SUITABILITY MODEL.

This approach (Appendix B) seems like an excellent start – but it is only a start. The reason for this emphatic assertion is that the resulting distribution map (Fig B-3 (page 90) does not match other distribution maps (Hay and McCarter 2000) or what we know about eulachon distribution.


N
These distributions appear to be consistent with other catch data
Habitat suitability
Eulachon are rare in the Strait of Georgia except for spawning times
This is an are a of high eulachon abundance
Juvenile eulachon are found in Barkley Sound

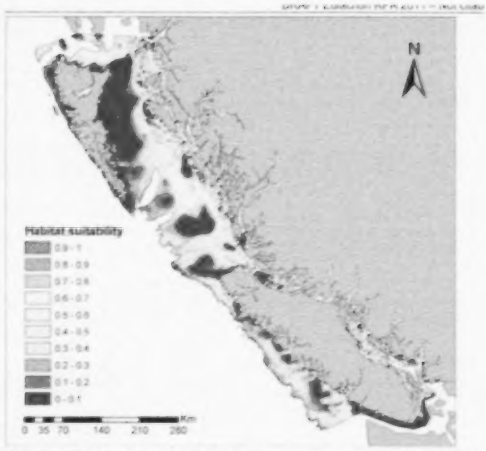


Figure D.3. Eulachon distributions from Hay and McCarter 2000.

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